Small Business Innovation Research/Small Business Tech Transfer

A Room-Temperature High-Speed Quantum Dot Infrared Photodetector with High Photodetectivity, Phase I

Completed Technology Project (2005 - 2006)

Project Introduction

The STTR Phase I proposal aims to develop innovative device concepts and fabrication techniques that enable the construction of high-performance uncooled long-wave infrared (LWIR, 8-12?Ym) photodetectors. LWIR photodetectors are of great importance in real-time acquisition of radiation characteristics of the Earth and its environments for understanding and predicting the Earth's climate and potential hazards. Quantum dot infrared photodetector (QDIP) technology offers an excellent choice for LWIR sensing due to its superior performance, including high temporal resolution (<1 ?Ys) and low noise equivalent temperature difference (NETD <10mK). However, existing QDIP technology requires cryogenic cooling to reduce dark current, which substantially increases size, weight and power consumption. Because of this, the proposed research aims to develop innovative device concepts and fabrication techniques that can substantially reduce dark current, thus allow the construction of uncooled QDIPs. The uncooled QDIP technology enables high-performance LWIR detecting on a chip with significantly reduced payload. It is highly desired in many Earth science applications. The Phase I work will perform feasibility investigation of the proposed device concept, optimize quantum dots growth and annealing techniques and produce a preliminary design for a prototype system that can be built and demonstrated in Phase II with a NASA supplied platform.

Anticipated Benefits

The ultra-sensitive, room temperature and spectral tuning capabilities make the proposed technology particularly useful in many Non-NASA applications requiring ultra-sensitive and standalone, including: (1) Night Vision (2) Ultra-sensitive missile early launch detection and high-speed trajectory tracking with non-false alarming (3) Continuous and standalone chemical and biological hazard detection (4) High definition three-dimensional medical imaging and reconstruction The proposed QDIP is especially useful for a number of potential NASA applications, including: (1) Real-time high-throughput, high definition acquisition of radiation characteristics of the Earth and its environments: The thermal-emission data provide critical information for understanding and predicting the earth's climate and potential hazards. The avoiding of large mass of cryogenic systems significantly reduces payload and power consumptions. (2) 3-D Robot Vision: 3d imaging and motion sensing for docking and robot-assisted assembly; Robot vision for micro-spacecraft, surface lander and rovers for planetary exploration. (3) Lidar remote sensing: topographical profiling and monitoring of atmospheric variables such as temperature, winds, and trace constituents providing landing site characteristics

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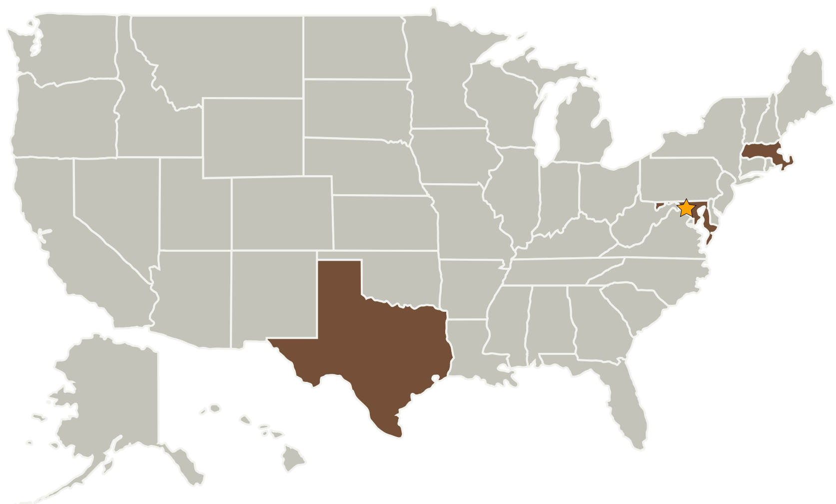
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland
Opin Technologies, Inc	Supporting Organization	Industry	Austin, Texas

Primary U.S. Work Locations	
Maryland	Massachusetts
Texas	

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Manager:

Peter K Shu

Principal Investigator:

Hao Chen

Technology Areas

Primary:

- TX08 Sensors and Instruments
  └ TX08.1 Remote Sensing Instruments/Sensors
    └ TX08.1.1 Detectors and Focal Planes